OPERA-CNGS/Fréjus-SPL

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1. Introduction

The poster presented the OPERA experiment and the SPL-Fréjus neutrino super beam project.

OPERA [1] is an experiment willing to see tau neutrino apperance. The detector is discribed in section 2 and the expected results are given.

Section 3 is deveted to the SPL neutrino super beam [2], wich search for θ_{13}. An optimisation of the SPL energy is proposed.

2. The OPERA experiment

The experiment is located in the Gran Sasso Laboratory and recieves the CNGS ν_μ beam created at CERN, 732 km form Gran Sasso. OPERA detectes the τ created by charged current interactions of oscillated ν_τ. The target is made of 1800 t of lead, cut in 1 mm thick plates, piled together with emulsion films inside bricks. The high space resolution of emulsion allows to identify the τ decay topology. There are more than 200,000 such brick in OPERA, arranged in walls. Hit bricks are localized using scintillator strips installed between the brick walls and two spetrometers allow to identify muons with their charge. This divides by a factor 20 the charm backgroud (charmed mesons have a decay topology similar to the tau, but they produce wrong charge muons).

If $\Delta m^2_{23} = 2.4 \times 10^{-3} eV^2$, one expect 10.5 ν_τ events identified in OPERA with an expected backgroud less than 0.7 event for 5 years running at 4.5×10^{19}pot/year.

3. The SPL neutrino super beam

Neutrino super beams ($\nu_\mu/\bar{\nu}_\mu$) can be used for the search of θ_{13} and δ_{CP}. ν_e appearance may be seen for instance in a 440 kt water Čerenkov detector located in a new cavity in the Fréjus laboratory at 130 km from CERN.

A 4 MW proton beam called Super Proton Linac (SPL) is under study at CERN. Its protons imping a mercury target to produce pions focalized by two concentric electromagnetic horns. Their shape have been optimised to produce 260 MeV neutrinos beam, which is the first oscillation maximum at $\Delta m^2_{23} = 2.5 \times 10^{-3} eV^2$. The horns are followed by a 40 m long, 2 m radius decay tunnel.

A full simulation of the beam line have been set up, including the target station, the focusing horns and the decay tunnel geometry. Special attention has been taken for the simulation of kaons background which is crucial for the SPL energy optimisation study [3]. It uses algorithm based on the probability that have any neutrino of the simulation to reach the detector.

Up to now, the nominal kinetic energy of the SPL is 2.2 GeV, but the result of [3] indicates that an energy of 3.5 GeV could improve the sensitivity by 20%, allowing to measure θ_{13} independetly of the value of δ_{CP} down to $\sin^2 2\theta_{13} = 2.02 \times 10^{-3}$, at 90% CL.

REFERENCES

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